

CURIOSITY



NASA/JPL-Caltech/MSSS



How to Boldly Go...

Guy Pyrzak
MSL IPE Team
1/29/13

STAR TREK



Curiosity's primary scientific goal is to explore and quantitatively assess a local region on Mars' surface as a potential habitat for life, past or present

- **Biological potential**
- **Geology and geochemistry**
- **Role of water**
- **Surface radiation**



NASA/JPL-Caltech



Curiosity's Science Objectives

Not This



This

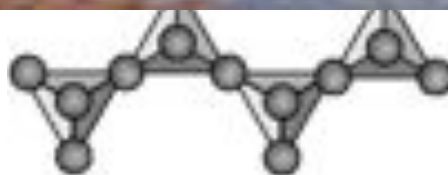


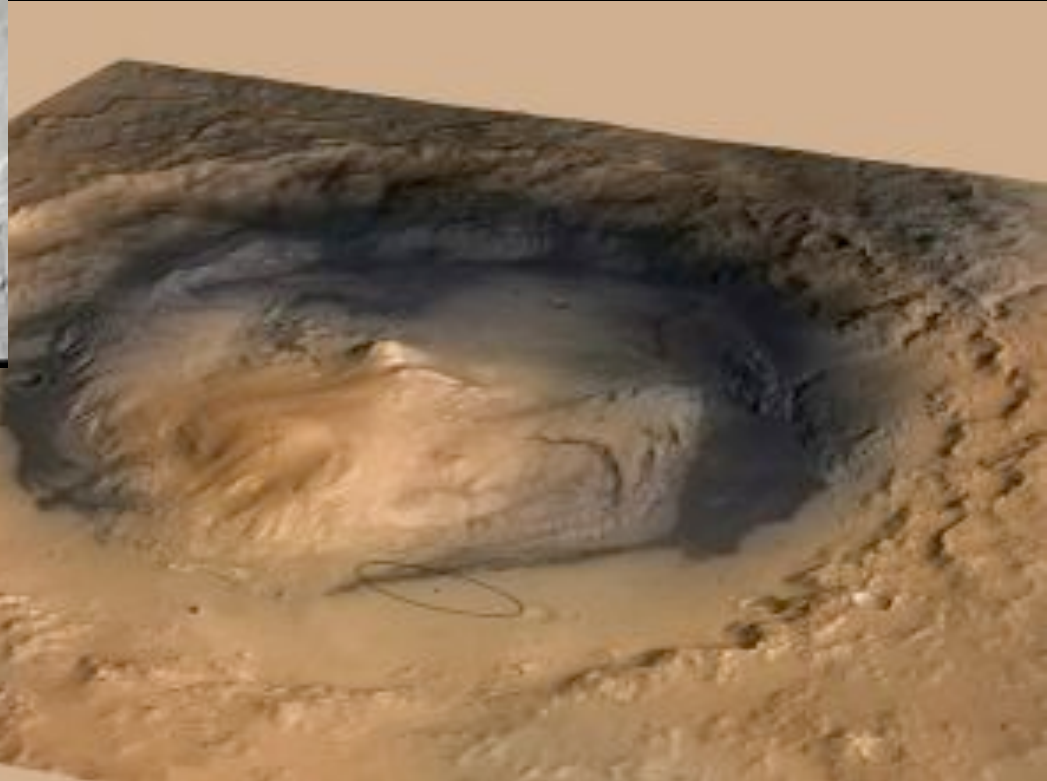
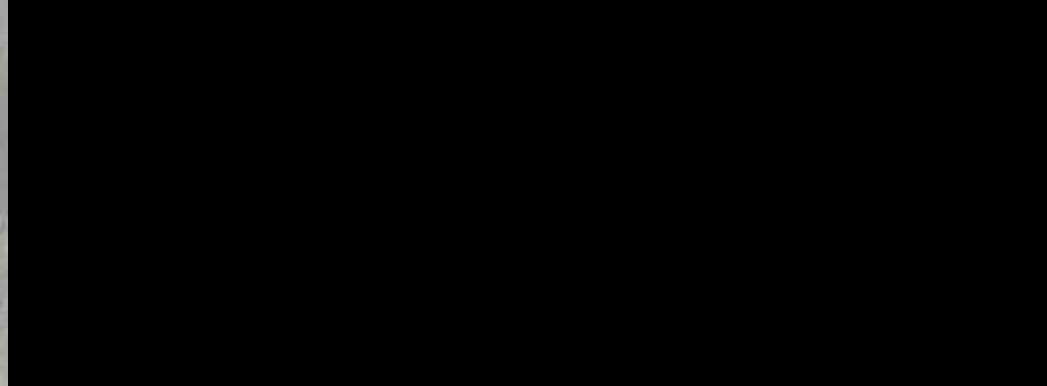
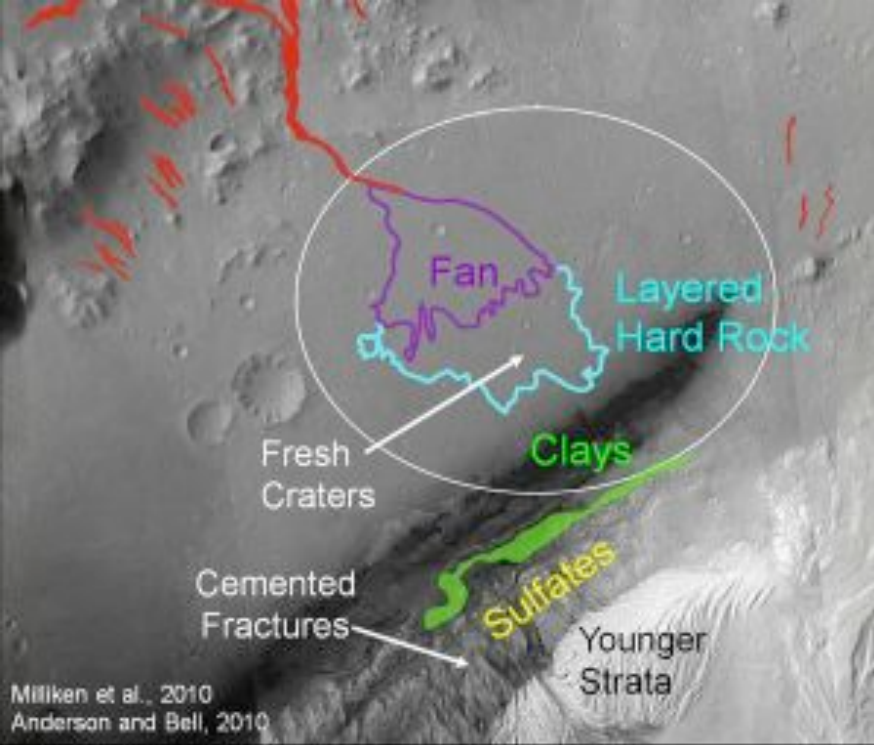
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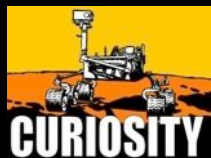
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NASA/JPL-Caltech

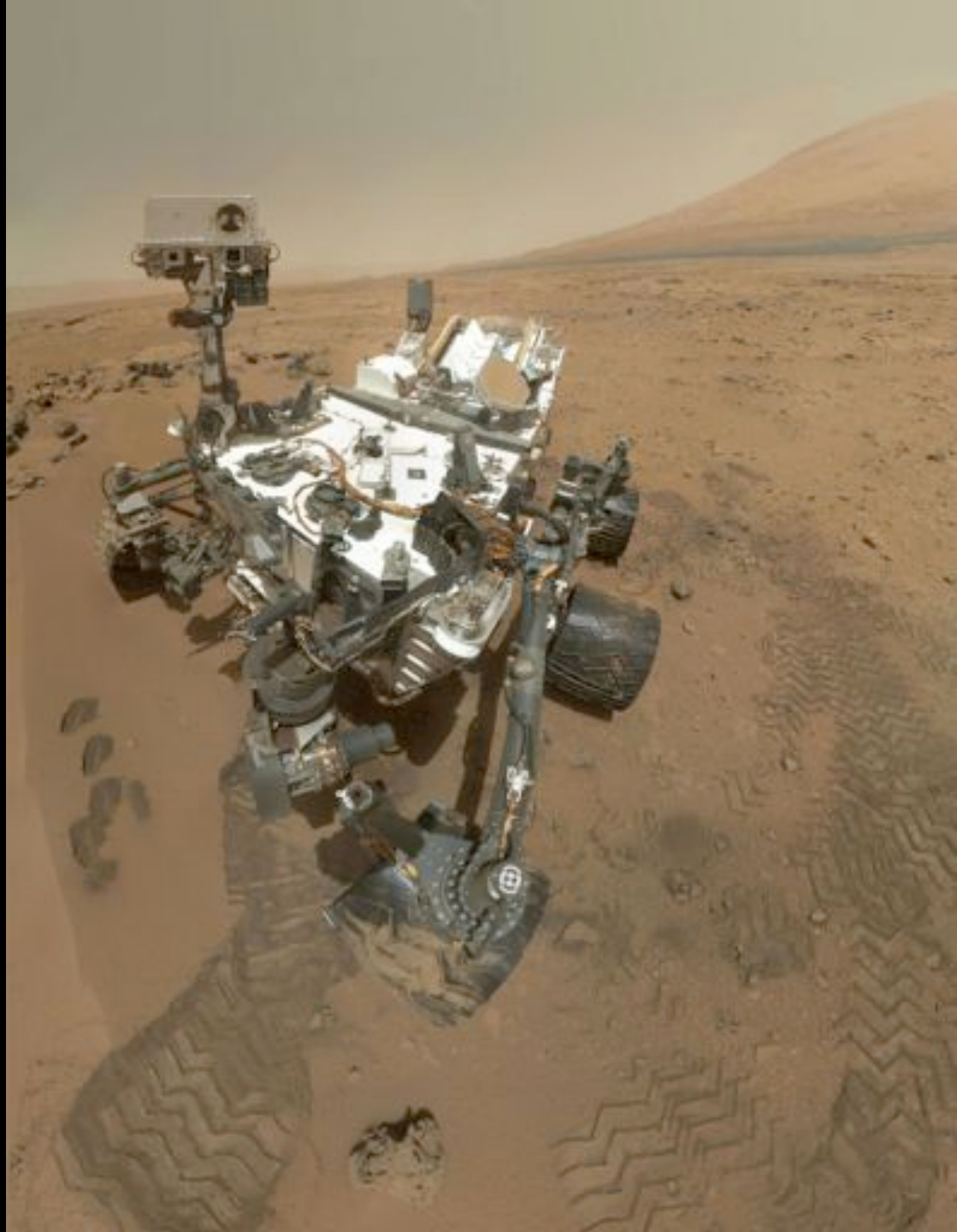
NASA/JPL-Caltech/ESA/DLR/FU Berlin/MSSS

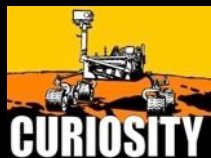
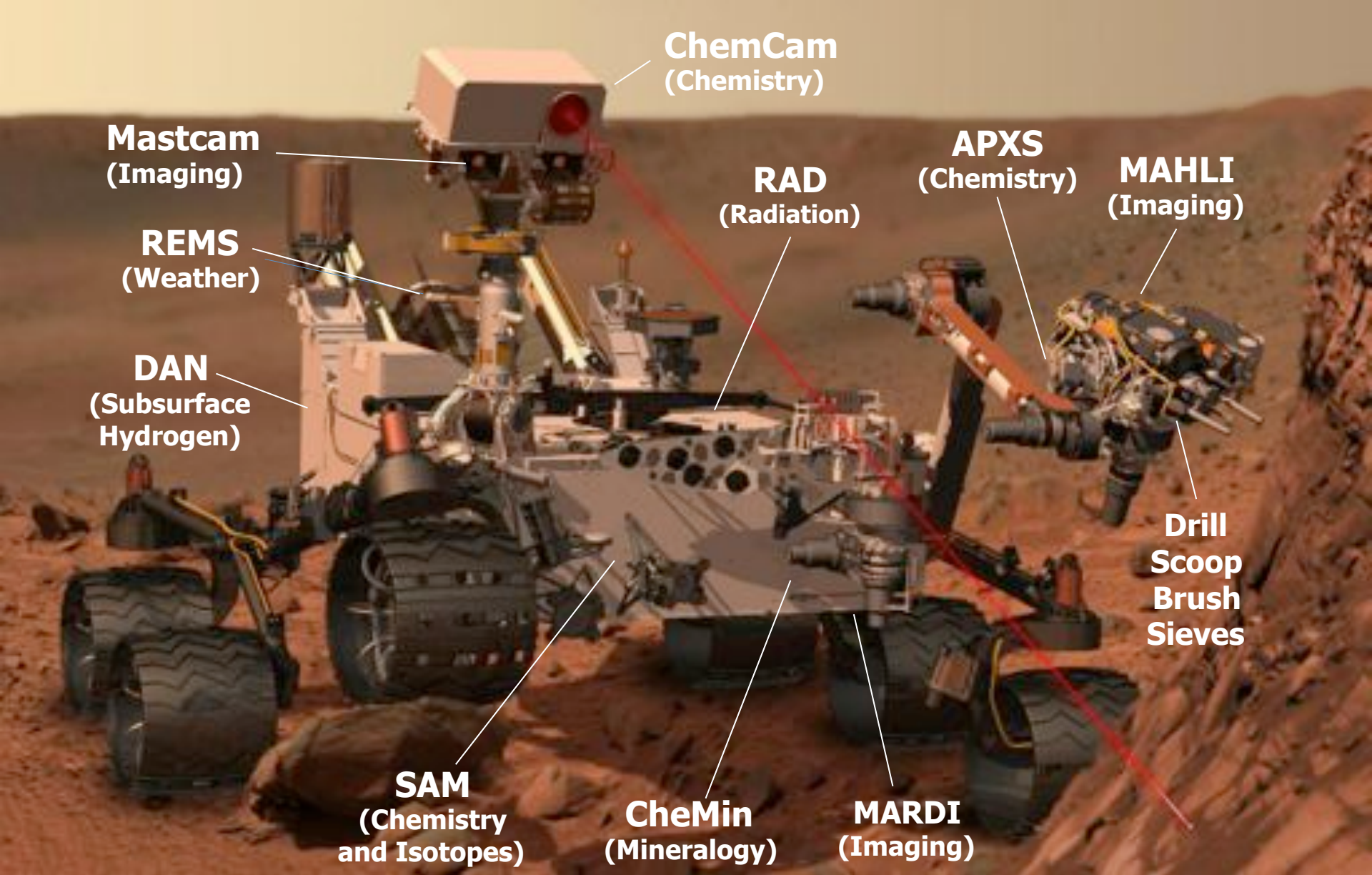


Target: Gale Crater and Mount Sharp

Curiosity Selfie Rocknest

Assembled from 55
MAHLI images





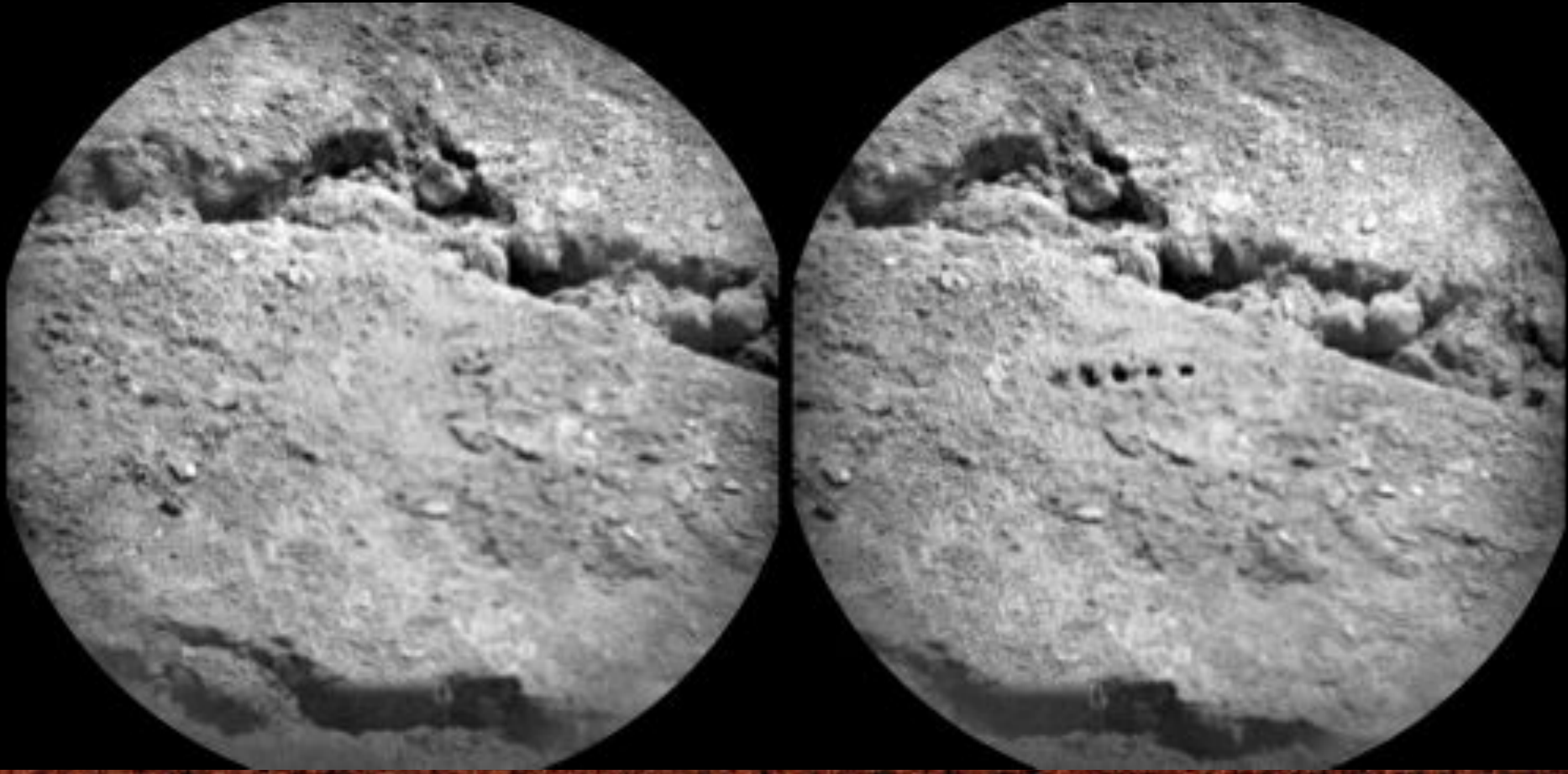
Curiosity's Science Payload

Curiosity vs Enterprise



Curiosity Rover (MSL)	Specs	USS Enterprise (NCC-1701)
900kg	Weight	397805 metric tons
2.9 m long, 2.7m wide, 2.2m	Dimensions	642m long, 467m wide, 137m
30 meters per hour	Maximum Speed	Warp 8
radioisotope thermoelectric generator	Power Source	matter/antimatter reactor
280	Crew	1012
17 cameras, SAM, Chemin, DAN, RAD, REMS, APXS	Science Instruments	Tricorders and "Sensors"
Chemcam, Percussive Drill	"Weapons"	Phasers & Photon Torpedoes

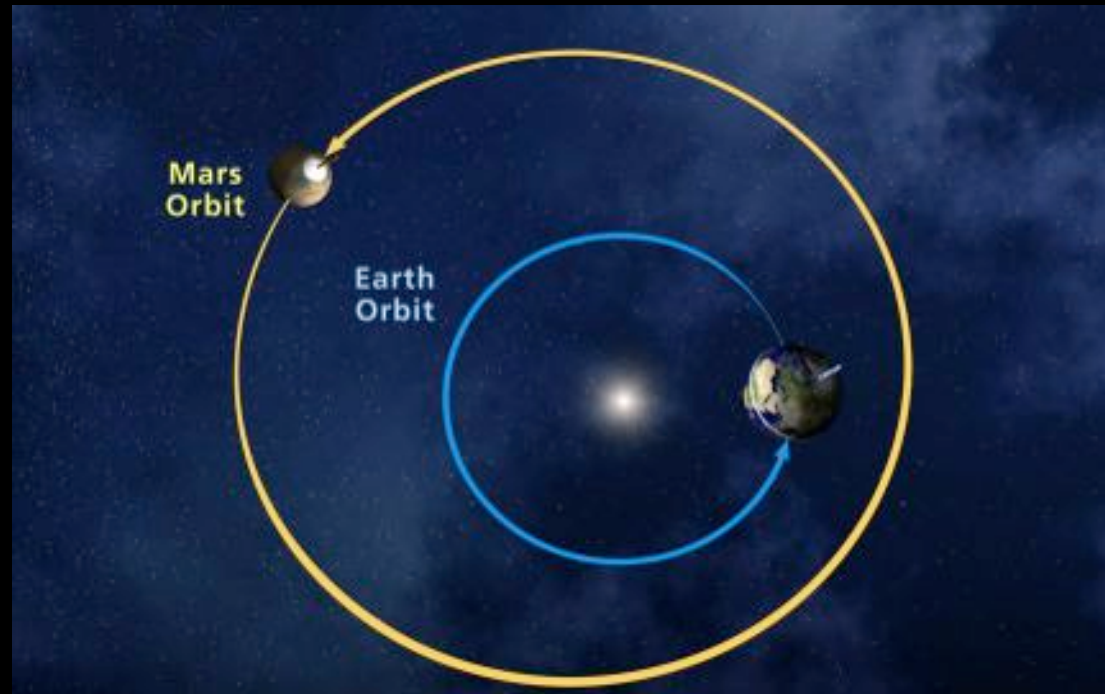
Lasers



Operating a Rover on Mars

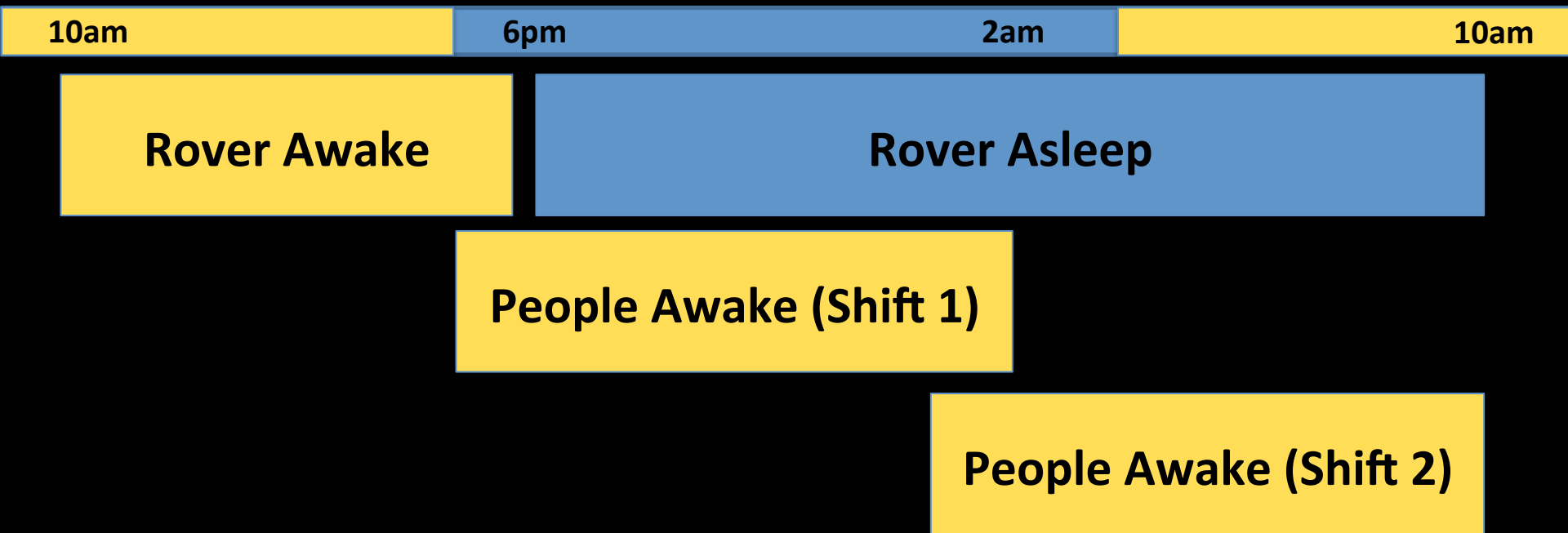


Depending on where Mars and Earth are in their orbits, it takes about 4-20 minutes for a signal to travel between the two planets.



MARS TIME

August 5th to Nov 5th



EARTH TIME - August 11, 2012



EARTH TIME Nov 5th to Now

08:00am PST

6:00pm PST

Shift 1

Shift 2

Rover Awake/Sleep cycle decoupled from Earth Operations

Rover Awake

Rover Asleep

World Wide Operations Team



**Russia, France, Spain, and all over
the United States**



Tactical
Uplink Lead

Team Chief

Engineering
Uplink Lead/
Tactical
Downlink Lead

Rover
Planners

Data
Management/
Telecom

Science Planner

STAR
TREK

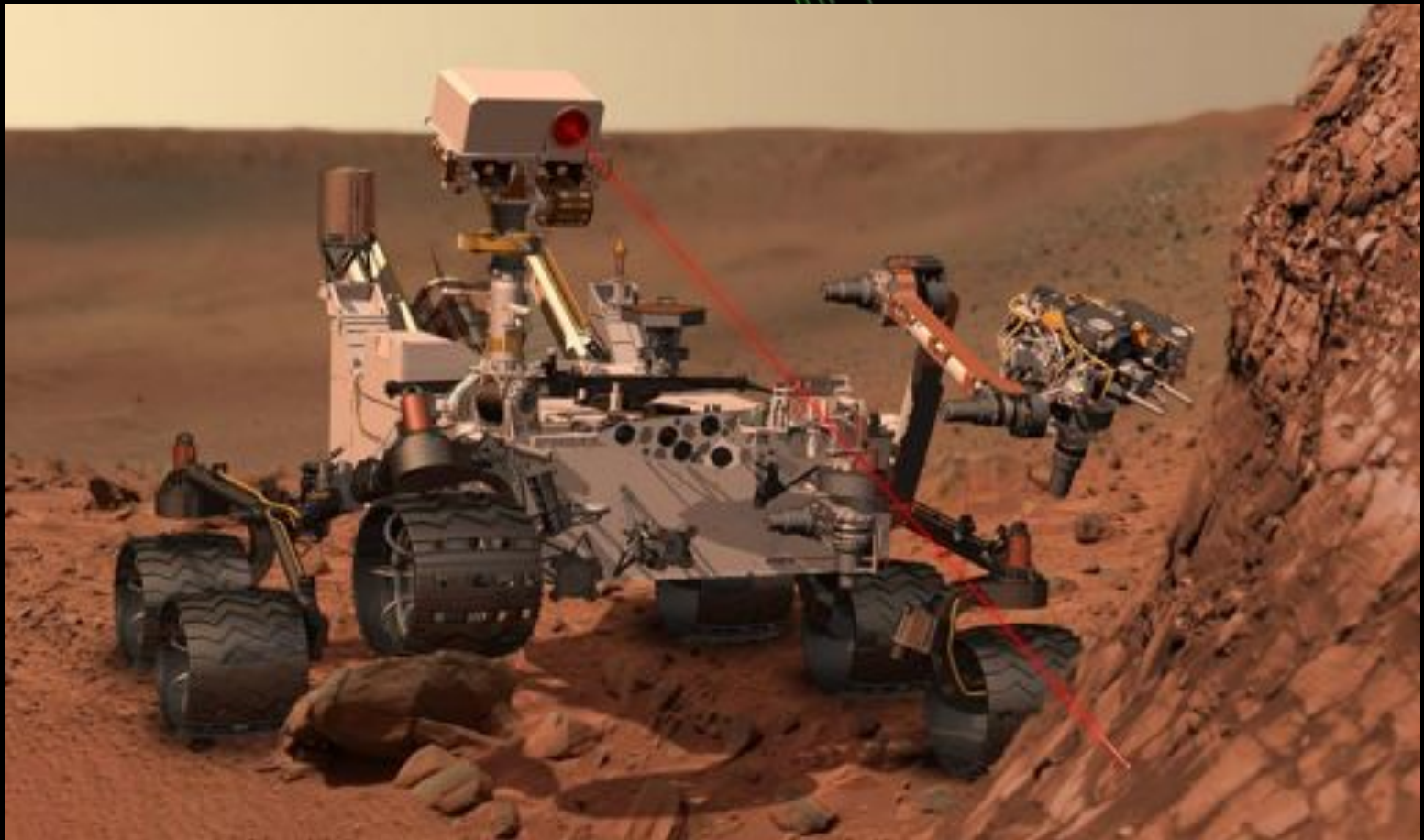
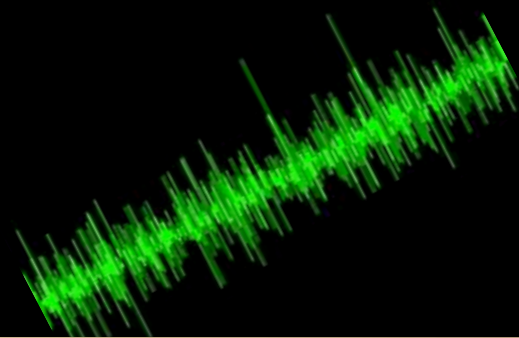
05.08.09
STARKREKMOVIE.COM

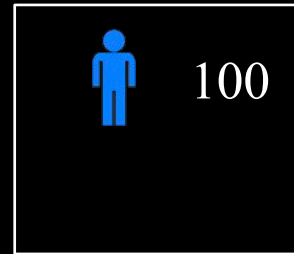
Science!



Science Operations Working Group Chair

Operations Lifecycle





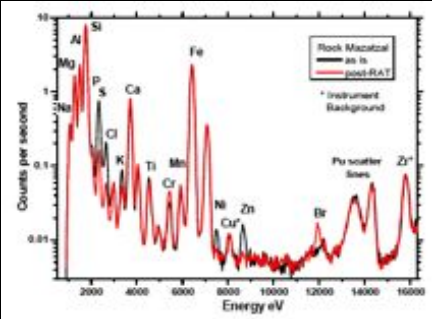
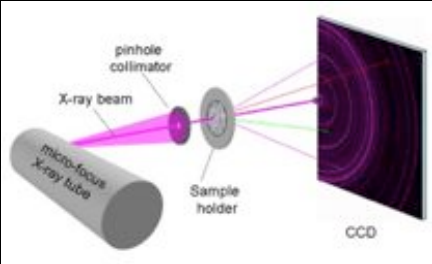
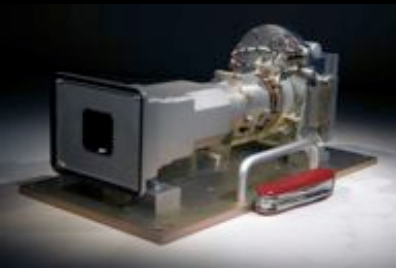
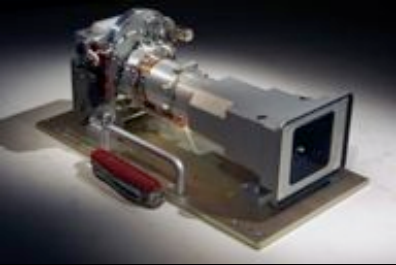
Surface Mission Support Area







Science Operations Working Group (SOWG)





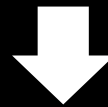
Plan



sequence12345.abc

1	rover_wa
2	extend_a
3	place_dr
4	drill_1m
5	retract_
6	rover_sl

Sequence



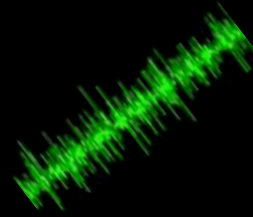
Binary

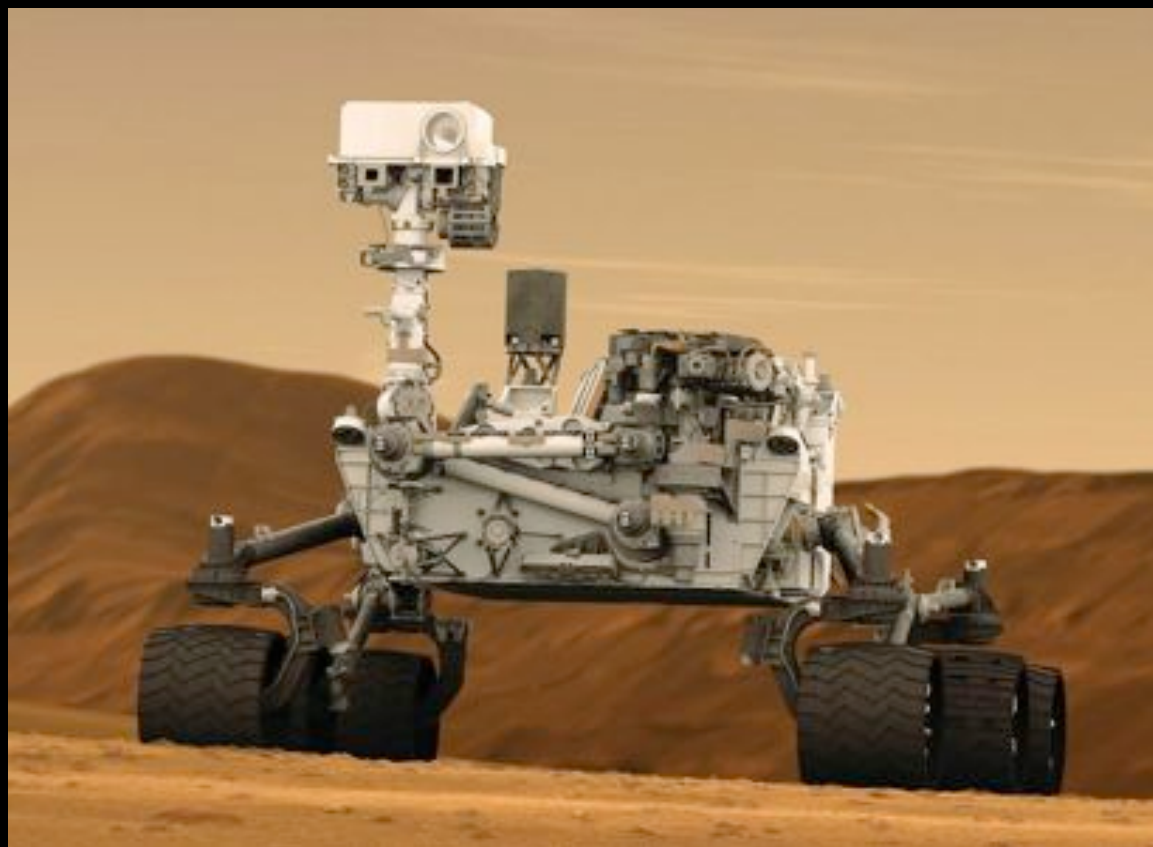
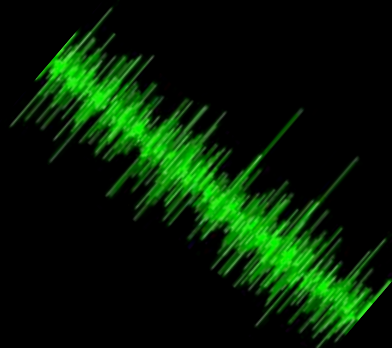




Sequencing Room







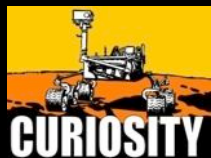
Mission Log



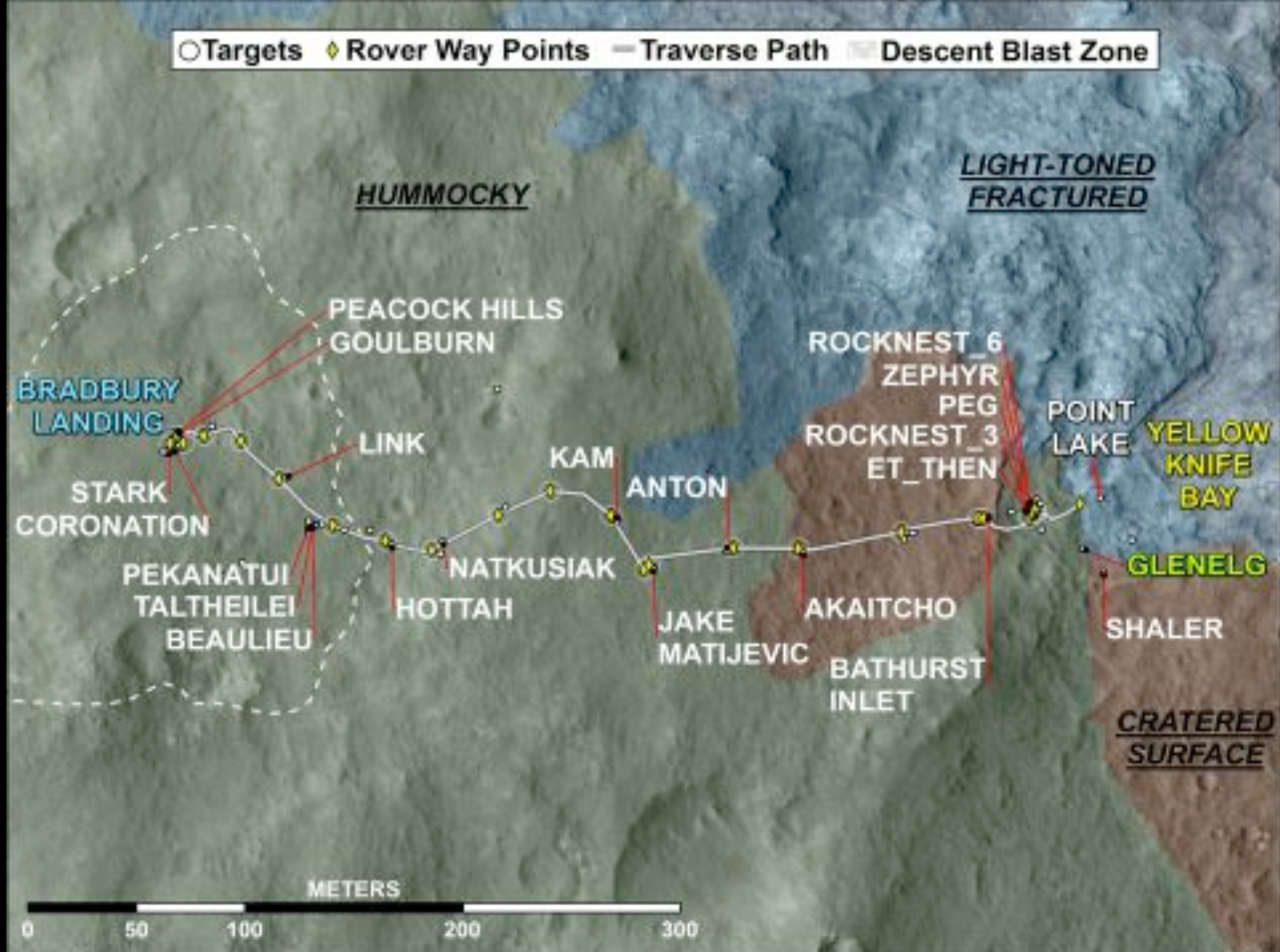


10 cm

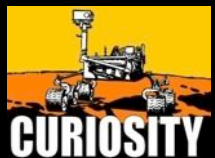
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Conglomerates at Hottah



NASA/JPL-Caltech/Univ. of Arizona



Curiosity is currently exploring Yellowknife Bay, a basin within the Glenelg region

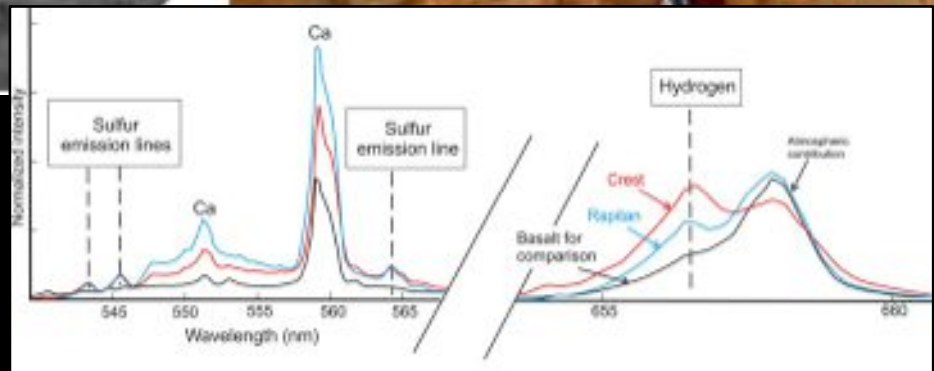
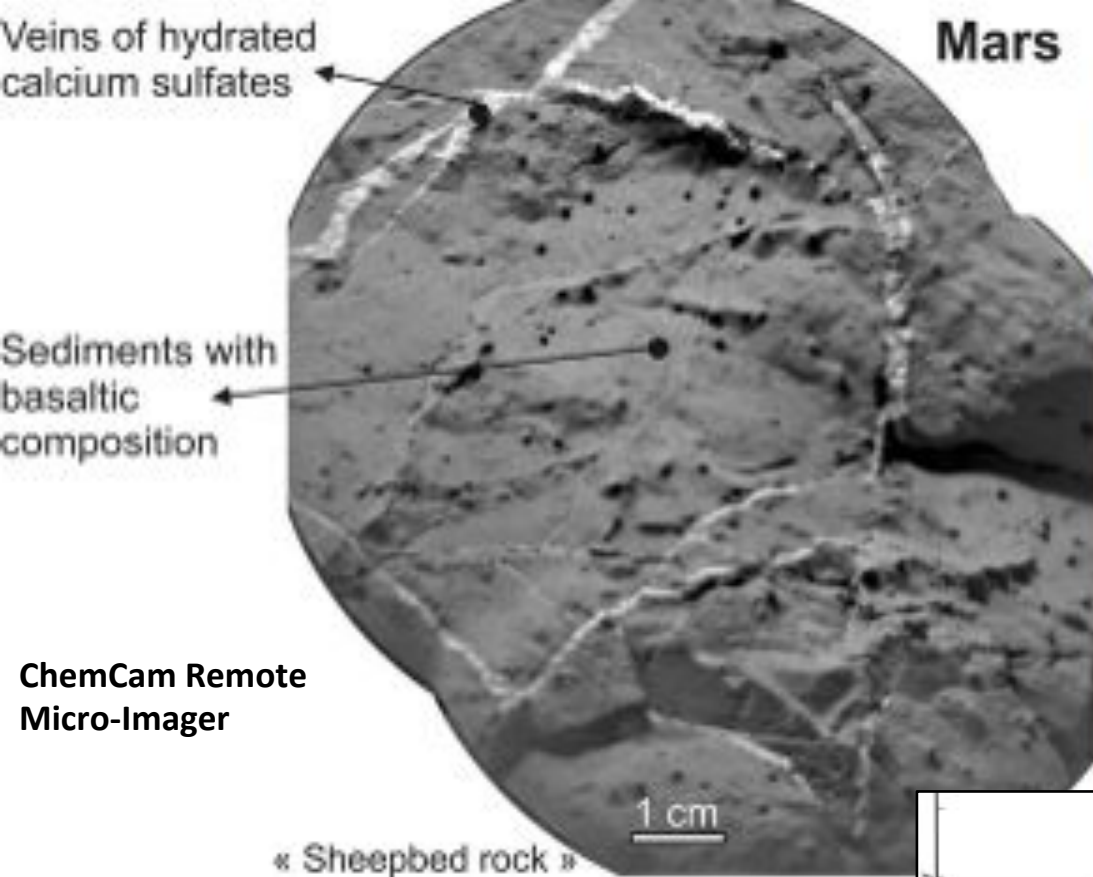


NASA/JPL-Caltech/MSSS

**Postcards from
Yellowknife Bay
showing a diversity of
rock types, fractures,
and veins**

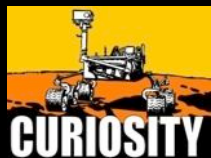


NASA/JPL-Caltech



ChemCam spectra from sol 125
“Crest” and 135 “Rapitan”

“Sheepbed” rocks contain 1 to 5-mm fractures filled with calcium sulfate minerals that precipitated from fluids at low to moderate temperatures





NASA/JPL-Caltech/Univ. of Arizona



Curiosity's ultimate goal is to explore the lower reaches of the 5-km high Mount Sharp

?



Thank you!

Backup

Engineers & Scientists



Damian Dovarganes,
ASSOCIATED PRESS - AP



NASA/HQ



Jet Propulsion Laboratory
California Institute of Technology



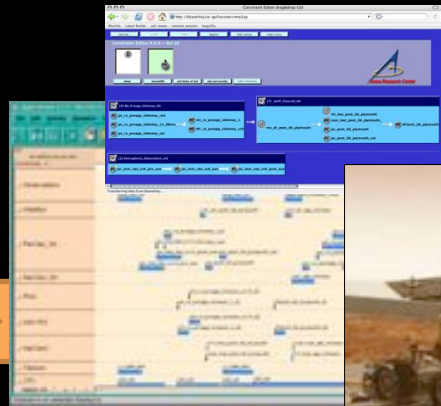
EXIT



What does MSLICE let them do?

- View images from mars in 2d and 3d.
- View a map of where the rover has been.
- Plan out which science instruments to use and how they will be used.
- The equivalent of grammar and spell checking... but for mars rovers.
- Simulate how much resources the plan will take.
- Turn the plan into the commands that will get sent to the rover.
- Share ideas!

Prior Ames Planning Tools



Mars Exploration Rovers
(2003)

Phoenix Science Interface



Phoenix Mars Lander
(2007)

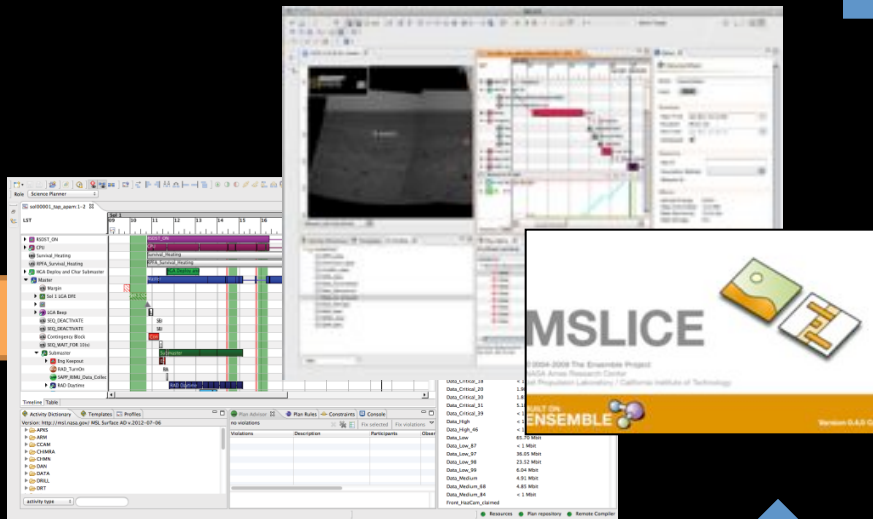


International Space Station

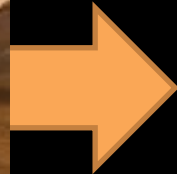


Score (ISS OPS PLAN)





**Mars Science Laboratory
(2011)**



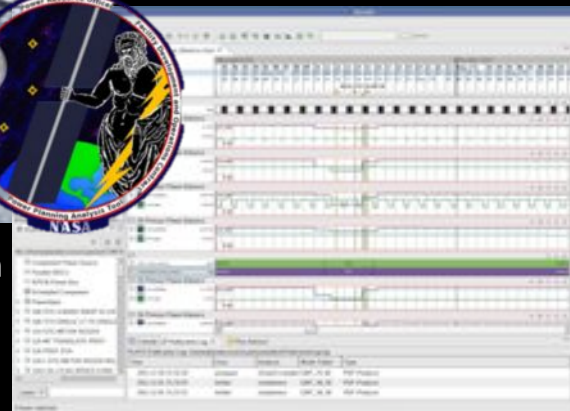
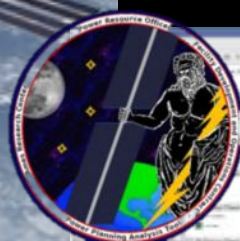
APEX (ISS ADCO)

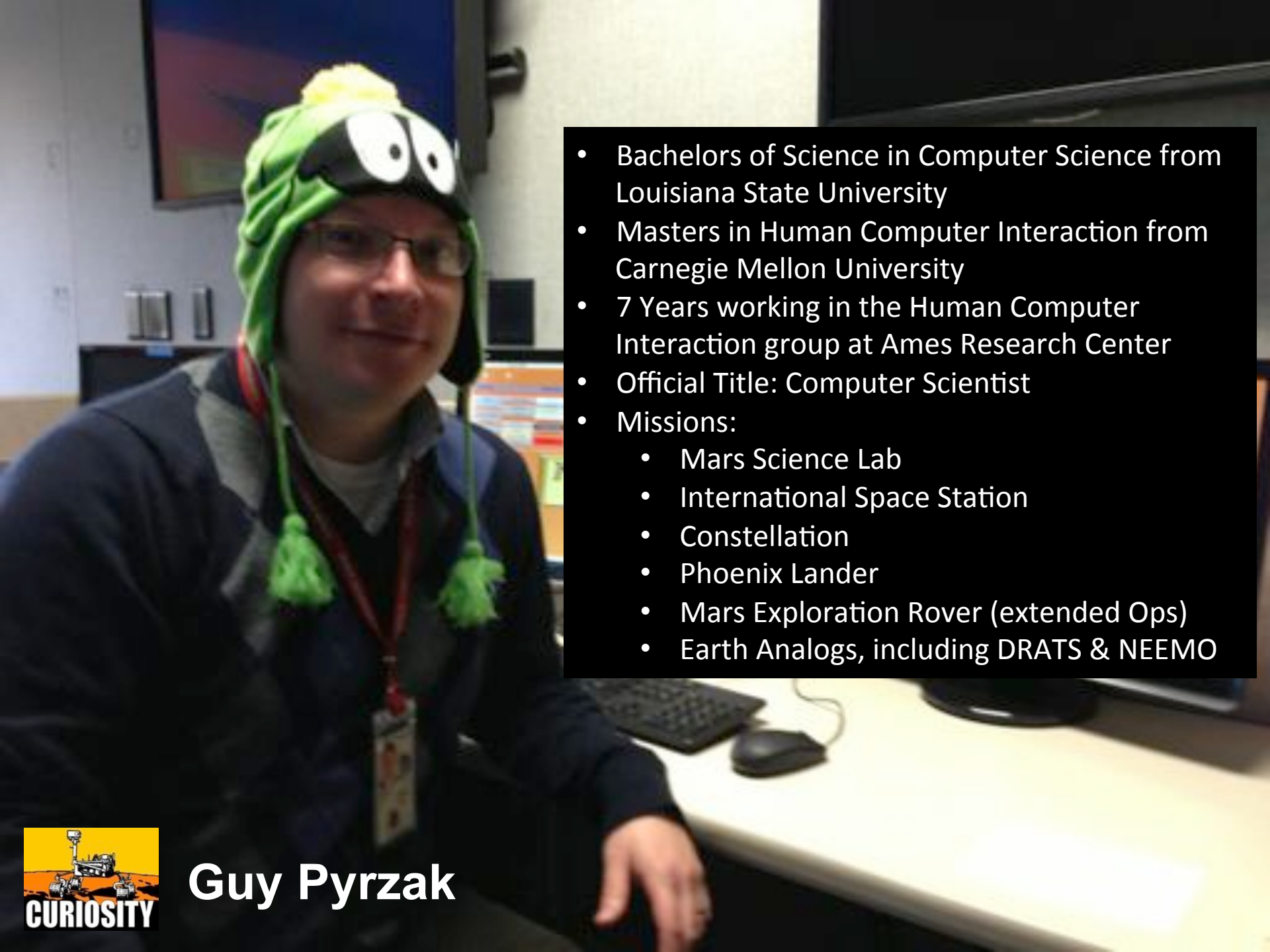


PLATO (ISS SPARTAN)



International Space Station





- Bachelors of Science in Computer Science from Louisiana State University
- Masters in Human Computer Interaction from Carnegie Mellon University
- 7 Years working in the Human Computer Interaction group at Ames Research Center
- Official Title: Computer Scientist
- Missions:
 - Mars Science Lab
 - International Space Station
 - Constellation
 - Phoenix Lander
 - Mars Exploration Rover (extended Ops)
 - Earth Analogs, including DRATS & NEEMO



Guy Pyrzak

1. REMOTE SENSING

- Landscape imaging
- Sampling of rock and soil chemistry



2. TRAVERSE/APPROACH

- Driving up to 100 m per sol
- Imaging and profiling chemistry along the drive
- Locating sampling targets



3. CONTACT SCIENCE

- Removal of surface dust
- Chemical and hand-lens observations of a specific target



4. SAMPLE ACQUISITION/ANALYSIS

- Drilling, processing, and delivering sample material to the rover's lab instruments
- Analyzing for mineralogy, organics, elemental and isotopic chemistry



Each activity may require multiple “sols”.
Results are reviewed on Earth before moving on to the next activity.
Weather and radiation monitoring occur on all sols.

Why Explore?



That may be the most important thing to understand about humans. It is the unknown that defines our existence. We are constantly searching, not just for answers to our questions, but for new questions. We are explorers. We explore our lives day by day, and we explore the galaxy, trying to expand the boundaries of our knowledge.